ROLLAPADU WILDLIFE SANCTUARY, WITH SPECIAL REFERENCE TO THE GREAT INDIAN BUSTARD *ARDEOTIS NIGRICEPS* (VIGORS)[1]

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(With two maps and a text-figure)

INTRODUCTION

The Rollapadu Wildlife Sanctuary is the most well-known place for the Great Indian Bustard *Ardeotis nigriceps* (Vigors) in Andhra Pradesh. The Sanctuary was established mainly due to the recommendations of the Endangered Species Project of the Bombay Natural History Society to the Andhra Pradesh Forest Department. The Society had a field station from September 1985 to May 1988 at Rollapadu. We give here an account of the Sanctuary, its flora, and fauna with special reference to the bustard, in an effort to provide baseline data for future researchers at Rollapadu.

LOCATION AND TOPOGRAPHY

Rollapadu is a small village (population 755, vide 1981 census) 18 km south-east of Nandikotkur town (15° 52'N ' 78° 18'E) in the plains between the Nallamalai and Erramalai ranges of the Eastern Ghats. The River Krishna flows northwest of Nandikotkur. The rocks belong to the Kurnool-Cuddapah formations. The soil is gravelly with heavy clay content and low permeability. Black cotton soil, preferred for agriculture, also occurs in the surrounding areas.

CLIMATE

The first three months of the year are pleasant with moderate winds from the southeast. The summer heat starts at the end of March, and April and May are the hottest months with temperatures soaring to 42° C. Towards the end of April, Rollapadu experiences dust storms accompanied by a few showers, giving respite from the heat. Rainfall is received from the SW and NE monsoons, with an average annual rainfall of 667.8 mm which varies from year to year. Cyclonic storms that hit the Andhra coast almost every year, especially during the NE monsoon period, result in continuous downpours at Rollapadu. Winter is mild and the coldest month is December (*c.* 18° C).

CONSERVATION MEASURES

After the 'rediscovery' of the bustard in August 1982, the Forest Department stopped all trapping activities. In 1983, on learning that the bustard frequented areas were to come under a sheep farming scheme, the Department took steps to acquire these lands. In April 1988, the acquired lands received the official designation of a sanctuary. The staff consists of a Forester, a Guard and seven watchmen. The Sanctuary is under the jurisdiction of the Conservator of Forests, Srisailam.

The area of the Sanctuary is 614 ha, divided into three blocks or enclosures. These enclosures are out-of-bounds for people and livestock and are bordered by trench-cum-mound walls (TCM). A system of roads, again bordered by TCM walls were also laid out in the enclosure to regulate the movement of people to their crop fields or villages–the right of way in the enclosure (along the roads) had to be ceded to the villagers as it was a traditional pathway and a route round the enclosure would put them to much difficulty and evoke antagonism for the Sanctuary. These roads, besides minimizing disturbance to the bustards, also act as fire breaks. A waterhole is present to help the animals tide over the hot summer.

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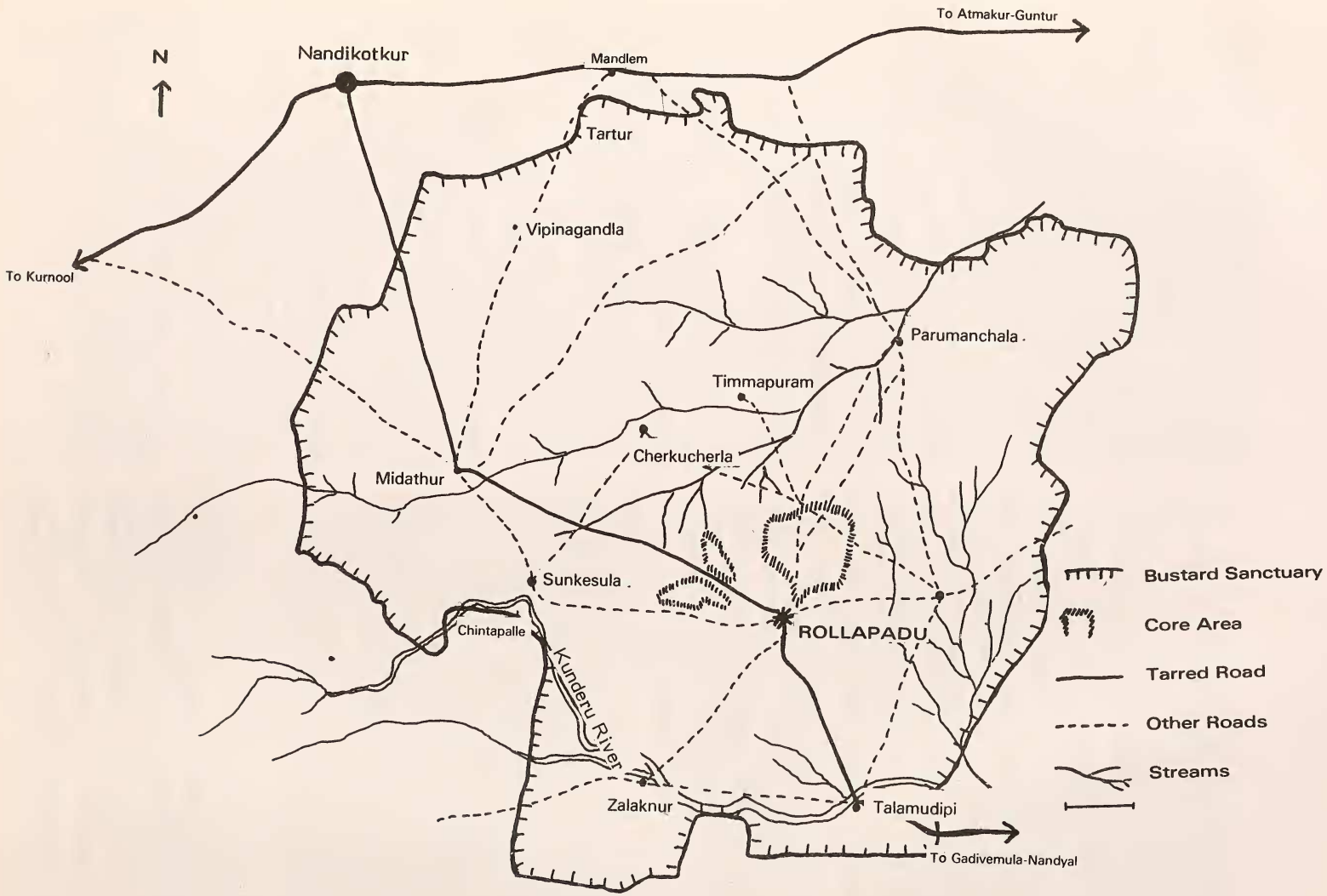


Map 1. Proposed Great Indian Bustard Sanctuary in Rollapadu

Vegetation

The vegetation of Rollapadu is of the Tropical Thorn Forest type (Champion & Seth 1968). However, human and human-related pressures have converted the landscape to one of crop fields, grazing lands and very light scrub.

The vegetation in the enclosure may be generally termed a grassland with a few scattered shrubs and trees. The common grass species are *Aristida funiculata, Chrysopogon fulvus, Eremopogon foveolatus, Heteropogon contortus* and *Iseilema anthephoroides*. During our stay period we observed that *H. contortus* spreads to more and more areas with each passing year. For example, a favoured nesting site of the bustard which was *E. foveolatus* dominant area in 1985 was overrun by *H. contortus* by 1987. Common herbs are *Alysicarpus scariosus, Boerhavia diffusa, Cleome felina, Indigofera cordifolia, Indigofera linifolia, Justicia procoumbens, Lepidagathis cristata, Polygala chinensis* and *Rhynchosia minima*. Shrubs and trees are represented by *Butea monosperma, Cassia auriculata, Cassia fistula, Canthium parviflorum, Diospyros melanoxylon, Morinda tinctoria, Prosopis spicigera, Randia dumetorum* and *Phoenix sylvestris*.

Owing to the absence of grazing and wood cutting, the vegetation in the enclosure has improved and contrasts sharply with the surrounding grazing lands. While the grass height in the enclosure exceeds 50 cm with good ground cover, the grazing lands exhibit the typical profile of the overgrazed lands of our country with short grass and much exposed bare ground. Another interesting difference in the vegetation of the enclosure to that of the grazing lands is with regard to the grass *Sehima nervosum*. Not a single specimen of *S. nervosum* has been recorded in the grazing lands, while they have even formed pure stands in some areas of the enclosure. Dabadghoa & Shankarnarayan (1973) classified the grasslands of these parts under the *Sehima/Dichanthium* cover — if allowed to reach the climax stage by factors like absence of grazing and fires. It will be interesting to see the final climax vegetation cover in the enclosure.

Most of the plants belong to what are termed as 'monsoon ephemerals'. Life for these plants begins with the onset of the monsoon in June, changing the bare brown/yellow landscape to lush greenery. The plants grow, flower, fruit, seed, and by the first week of December almost all the plants have died.

Fauna

The Sanctuary, though established primarily to protect the bustard, has benefited rest of the wildlife in the area. Prior to its establishment, the animals were persecuted by professional trappers and hunters from nearby towns and villages. These activities were checked with the posting of Forest Department personnel. Poaching of the bustard, florican and blackbuck (and all wildlife that inhabit the enclosure) is almost nil, but hunting of other species especially quail, partridge, sandgrouse, duck, barheaded geese, demoiselle crane continues on the sly in the surrounding areas.

Great Indian Bustard

The bustard was known to exist in the 'dry districts' of Andhra Pradesh. Hume & Marshall (1879) reported their presence in the "Nizam's territory". Elliot (1880) gave an account of falconers going in for the bustard and also stated that bags were so poor that a successful falconer was conferred with a village 'Inam' (or free tenure). Tostems (1887) saw a few bustards in the cold season in Kurnool district. Later Blanford (1898), writing on the distribution of the bustard in the Indian subcontinent, mentioned 'Hyderabad territories'. Burton (1953) gave more precise data by stating that in the 1890s, he saw 17 birds (of which 13 were in a flock) near Guntakal.

Till recently, little was known regarding the present status of the bustard in Andhra Pradesh. Pushp Kumar (1980), on the basis of information gathered from hunters and Forest Department Personnel, offered a rough estimate of 15 birds for the whole state. Then in August 1982, their

presence was recorded when a few birds were sighted at Rollapadu and Banganapalle in Kurnool district. In July 1984, the largest recorded flock in recent times of 35 bustards was sighted at Rollapadu (Ali & Rahmani 1982-84). The bustard is now known to exist at Rollapadu, Banganapalle, Nelliibanda, Peddapadu, Siruvella, Palakurti and Malligeli in Kurnool district; Hanimireddy-palli in Anantapur district; Chevalla and Shamshabad in Rangareddy district; and there are unconfirmed reports of their presence in some parts of Mahboobnagar district (Manakadan & Rahmani 1986).

Till the posting of watchmen at Rollapadu in August 1982, the bustard was hunted regularly by professional trappers. The shikaris put the number of birds bagged each year at about a dozen. The birds were were trapped by laying nooses at display sites, groundnut fields and waterholes–and were sold at the Nandikotkur market. The shikaris have no idea of the former population, except saying that the birds were scattered then and traps were laid when they noticed a few birds frequenting an area, unlike now, where they congregate at Rollapadu. The present population is in the range of 60-100 birds, judging by daily counts done, flock sizes seen and the number of nests located each year. An exact population estimate is not possible since the bustards move a lot and those that frequent the enclosure are mainly breeding birds.

Movement and Flock Composition: The movement and flock composition of the bustard depends much on the season and local weather conditions. Sexes generally remain separate and mixed flocks are rare and temporary (Rahmani & Manakadan 1986a). With the onset of the SW monsoon in early June, there is an influx and congregation of bustards in the grasslands of Rollapadu. June to August is the period when both largest numbers and largest flock sizes are seen (Tables 1 & 2). For example, in May 1986, mean group size of the males was 1, in June 4.4, in July 7.5 and 3.4 in August. Similar results were obtained in 1987, i.e. largest flocks of males were seen between June and August (except for February, when a flock of 7 and another of 4 birds were seen: but the sample size is very small (Table 1). The flocks were mainly unisexual, there being a very clear segregation of the sexes; fixed flocks are rare. For example, between June and August 1986, only one mixed flock of 3 birds (0.92%) out of 108 flocks was seen. Similarly, during the same period in 1987, only 5 (3.7%) of 132 flocks were of both sexes.

By mid-August, the major breeding season starts (Fig. 1) and soon the adult hens separate from the flocks to commence nesting. Adult cocks also form territories and become more and more solitary. Between June to August, around 50% of the sightings were of solitary birds, but from September onwards (Tables 3 & 4), these sightings increased to nearly 80%. In September 1986 (Table 3), 96.7% sightings were of solitary bustards. Non- breeding hens and cocks frequent the Rollapadu grasslands much less between September and December. For reasons still not clear, rainy days result in an influx of birds, the birds moving out again with the dry spell. The dominant cocks seem less pugnacious during rainy days and tolerate the presence of other males.

By the first week of December, the grasslands become more and more dry and only the displaying cocks and hens with chicks are seen. By January, only the territorial cocks and some late nesters are left in the enclosure area. However, bustards are seen in small droves of 2 to 7 individuals in the nearby areas. The months of February, March and the first half of April may be considered as the lull period for bustards as far as the grasslands of Rollapadu are concerned, since there is no breeding activity and the birds have moved out into the surrounding areas. However, in 1988, a few birds were present during this period also possibly due to the delayed monsoon of 1987.

By the third week of April, dust storms with scattered rains and showers occur. This weather heralds the onset of the 'minor breeding season', which extends till late May or early June. a few cocks and hens frequent the area and two or three nests are located every year (Table 5). Most sight-

ings are of solitary birds. With the onset of the monsoon at the end of June, the cycle repeats itself.

Breeding: The most interesting aspect of the breeding cycle is the existence of two breeding seasons–a major and a minor–at Rollapadu, unlike only one breeding season in the other areas studied. At Nanaj in Solapur district, Maharashtra, the bustard breeds during the monsoon period, while at Karera in Shivpuri district, Madhya Pradesh, they breed during summer. At Rollapadu, the major breeding season begins around mid-August and eggs may be laid till January. The minor breeding season begins with the onset of drizzles or rains in the third week of April and the season (judging from display activity) lasts till late May or early June. The reason for the existence of two breeding seasons at Rollapadu remains unexplained as we were not allowed to ring or band the birds for our studies. We do not know whether different individuals come to breed in the two seasons or birds which were unsuccessful in one season come to breed in another.

The courtship display activity is also interesting. In the 1985 major breeding season and the 1986 minor season, only one male (Meeta Male — see Map 2) displayed. A few other males also displayed but only in the absence of the Meeta Male or when he was less pugnacious as on rainy days or for some inexplicable reasons. In the 1986 major season, the Meeta Male fought with a few other males that came to display in his territory, after which there was little display activity that season. In the following minor season of 1987, only one male displayed at the same display site.

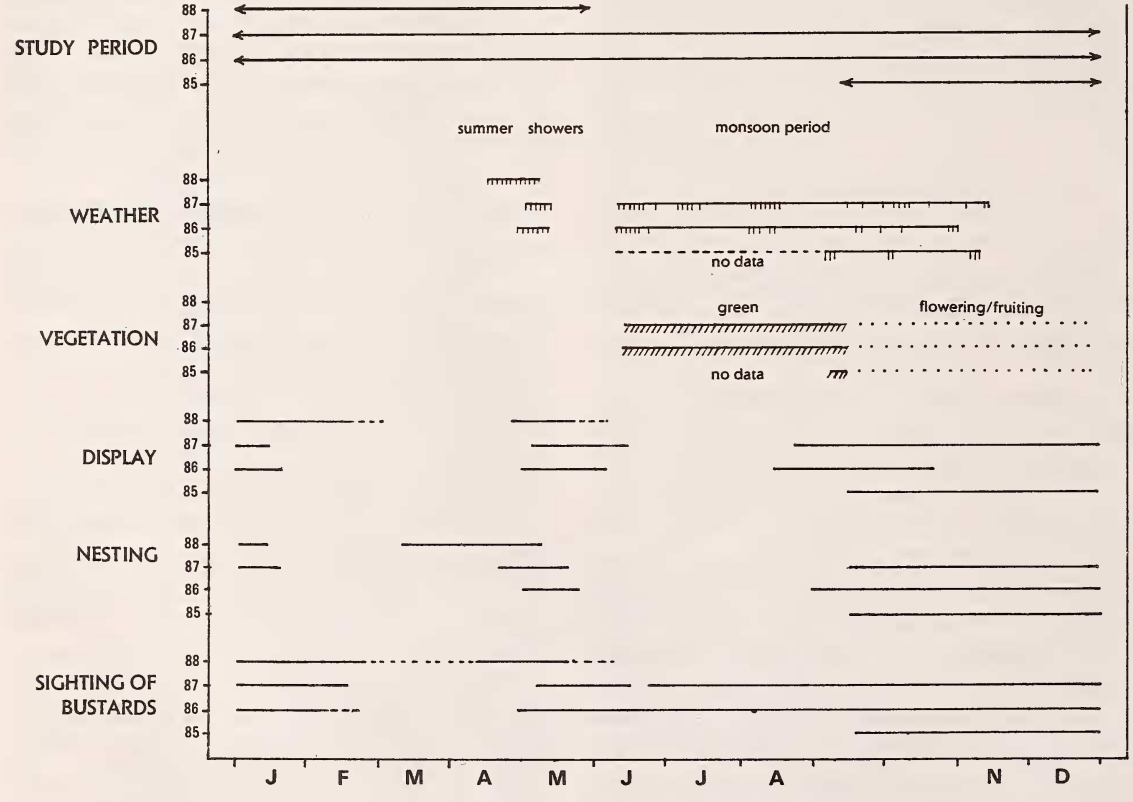


Fig. 1 Phenology of Events (September 1985-June 1988) at Rollapadu

TABLE 1

FLOCK SIZE IN DIFFERENT MONTHS IN 1986 AT ROLLAPADU

Flock Size	January			February			March			April			May			June			July			August			Septemper			October			November			December		
	M	F	M1	M	F	M1	M	F	M1	M	F	M1	M	F	M1	M	F	M1	M	F	M1	M	F	M1	M	F	M1	M	F	M1	M	F	M1	M	F	M1
1.	3	5	-	-	1	-	-	-	-	3	-	-	21	3	-	5	1	-	2	10	-	9	17	-	23	36	-	36	48	-	10	24	-	18	36	-
2.	1	3	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-	4	4	-	7	5	-	1	-	-	2	4	-	5	6	-	3	3	-
3.	1	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	4	3	-	4	-	-	1	-	-	1	1	-	5	-	-	1	-	-
4.	3	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	4	-	-	-	-	-	-	-	-	4	-	-	1	-	-
5.	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	1	-	-	3	-	-	1	2	-
6.	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	3	-	-	1	-	-	-	-	-
7.	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	3	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-
8.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean group size	3	1.8	4.6	5.5	1	5.5	-	-	-	1.2	-	-	1	1	-	4.4	1.5	3	7.5	1.5	-	3.4	1.2	-	1.1	1	-	1.5	1.1	-	2.7	1.2	-	1.5	1.3	-
Mean group size of both sexes	2.6			4.6			0			1.2			1			3.8			5.2			2.5			1			1.3			1.9			1.4		

M = Male; F = Female; M1 = Mixed Flock.

TABLE 2

FLOCK SIZE IN DIFFERENT MONTHS IN 1987 AT ROLLAPADU

Flock Size	January			February			March			April			May			June			July			August			Septemper			October			November			December		
	M	F	M1	M	F	M1	M	F	M1	M	F	M1	M	F	M1	M	F	M1	M	F	M1	M	F	M1	M	F	M1	M	F	M1	M	F	M1	M	F	M1
1.	17	15	-	4	-	-	-	-	-	2	-	-	14	11	-	14	3	-	7	7	-	10	4	-	41	35	-	85	40	-	67	11	-	68	10	-
2.	-	11	-	-	4	-	2	-	-	3	-	-	2	4	-	6	6	-	2	5	-	1	10	-	1	4	-	2	10	-	2	7	1	-	12	-
3.	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1	-	3	-	-	-	-	3	5	-	1	5	-	1	2	-	1	1	-
4.	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	4	1	-	3	4	-	1	2	-	1	2	-	-	-	-	-	5	-
5.	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	2	-	-	3	1	-	2	-	-	-	-	-	2	1	-	-	-	-
6.	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	4	-	1	-	1	-	-	-	-	-	1	-	-	-
7.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	1	1	-	-	-	-	-	-	1	-	-	-	-	1	-
8.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
9.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	1	-	-	-	-	-	-	-	-	-	-	-	-	-
11.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Mean group size	1	1.8	-	1	2	-	2	-	-	1.6	-	-	1.1	1.2	-	2.4	1.8	4.7	3.8	1.8	-	4.4	3.7	12	1.4	1.3	6	1.0	1.4	7	1.0	1.7	4	1	2.2	-
Mean group size of both sexes	1.5			1.5			2			1.6			1.1			2.5			3			4.2			1.5			1.2			1.2			1.3		

TABLE 5

NUMBER OF EGGS LAID IN DIFFERENT MONTHS*

Year	J	F	M	A	M	J	J	A	S	O	N	D	Remarks
1985	-	-	-	-	-	-	-	1	4	4	2	-	2 hatched shell remains located after January 1985
1986	-	-	-	2	-	-	-	2	1	3	1	2	-
1987	1	-	-	2	1	-	-	-	6	6	3	3	2 hatched shell remains located after January 1987
1988	2	-	-	2	-	-	-	-	-	-	-	-	-

* Study period: August 1985 to May 1988.

TABLE 3

NUMBER OF GROUPS (n) AND PERCENTAGES (%) OF BUSTARDS IN DIFFERENT MONTHS AT ROLLAPADU – 1986

Group	January		February		March		April		May		June		July		August		September		October		November		December	
Size	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
1.	8	34.7	1	20	-	-	3	75	24	100	6	50	12	27.9	26	49	59	96.7	84	87.5	34	57.6	54	83
2.	4	17.3	-	-	-	-	1	25	-	-	1	8.3	8	18.6	12	22.6	1	1.6	6	6.2	11	18.6	6	9.2
3.	5	21.1	-	-	-	-	-	-	-	-	1	8.3	7	16.2	4	7.5	1	1.6	2	2	5	8.4	1	1.5
4.	3	13.0	1	20	-	-	-	-	-	-	-	-	2	4.6	4	7.5	-	-	-	-	4	6.7	1	1.5
5.	1	4.3	1	20	-	-	-	-	-	-	-	-	-	-	2	3.7	-	-	1	1	3	5	3	4.6
6.	1	4.3	1	20	-	-	-	-	-	-	-	-	1	2.3	1	1.8	-	-	3	3.1	1	1.6	-	-
7.	1	4.3	1	20	-	-	-	-	-	-	1	8.3	3	6.9	1	1.8	-	-	-	-	1	1.6	-	-
8.	-	-	-	-	-	-	-	-	-	-	1	8.3	-	-	-	-	-	-	-	-	-	-	-	-
9.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1.8	-	-	-	-	-	-	-	-
10.	-	-	-	-	-	-	-	-	-	-	2	16.6	-	-	-	-	-	-	-	-	-	-	-	-
11.	-	-	-	-	-	-	-	-	-	-	-	-	1	2.3	-	-	-	-	-	-	-	-	-	-
12.	-	-	-	-	-	-	-	-	-	-	-	-	2	4.6	2	3.7	-	-	-	-	-	-	-	-
13.	-	-	-	-	-	-	-	-	-	-	-	-	1	2.3	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-	1	2.3	-	-	-	-	-	-	-	-	-	-
15.	-	-	-	-	-	-	-	-	-	-	-	-	2	4.6	-	-	-	-	-	-	-	-	-	-
16.	-	-	-	-	-	-	-	-	-	-	-	-	3	6.9	-	-	-	-	-	-	-	-	-	-

TABLE 4

NUMBER OF GROUPS (n) AND PERCENTAGES (%) OF BUSTARDS IN DIFFERENT MONTHS AT ROLLAPADU — 1987

Group	January		February		March		April		May		June		July		August		September		October		November		December	
Size	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
1.	32	68	4	50	-	-	2	40	25	80.6	17	47.2	14	37.8	14	26.4	76	79.1	125	85	78	82.1	78	79.5
2.	11	23.4	4	50	2	100	3	60	6	19.3	6	16.6	7	18.9	11	20.7	5	5.2	12	8.1	10	10.5	12	12.2
3.	1	2.12	-	-	-	-	-	-	-	-	3	8.3	3	8.1	-	-	8	8.3	6	4.0	3	3.1	2	2.0
4.	1	2.12	-	-	-	-	-	-	-	-	3	8.3	5	13.5	7	13.2	3	3.1	3	2	-	-	5	5.1
5.	1	2.12	-	-	-	-	-	-	-	-	4	11.1	2	5.4	4	7.5	2	2.0	-	-	3	3.1	-	-
6.	1	2.12	-	-	-	-	-	-	-	-	1	2.7	1	2.7	4	7.5	2	2.0	-	-	1	1.0	-	-
7.	-	-	-	-	-	-	-	-	-	-	-	-	3	8.1	2	3.7	-	-	1	0.6	-	-	1	1.0
8.	-	-	-	-	-	-	-	-	-	-	1	2.7	1	2.7	3	5.6	-	-	-	-	-	-	-	-
9.	-	-	-	-	-	-	-	-	-	-	1	2.7	1	2.7	2	3.7	-	-	-	-	-	-	-	-
10.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	9.4	-	-	-	-	-	-	-	-
12.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1.8	-	-	-	-	-	-	-	-

Since we worked with unbanded birds, we could not identify individual birds.

Initially, we presumed that the cock that frequented and displayed at the same site had to be the same bird, but *shikaris* told us that it was their experience that it need not necessarily be so. They say that the site where Meeta Male displays has been a traditional display spot for years and as soon as a displaying cock was caught another would replace him within a day or two. In one season about 8 years ago, they were able to noose and trap 5 displaying cocks from the same spot, one subsequently replacing the other. Hence, we are not certain if the cock termed Meeta Male by us, was the same bird throughout the season/seasons.

In the 1987 major season, two other males (Taggu and Bailpadu cocks — see Map 2) established territories in other areas in the enclosure, all three being separated by about half kilometre from each other. Adding to the confusion, only the Meeta Male displayed in the following minor season (1988). Bailpadu Male displayed for only two days. A male frequented the Taggu area for some days but no display activity was noticed. The pattern of display activity is confusing. Four or five years of studies on banded birds may give a clearer picture of the territoriality of the bustard.

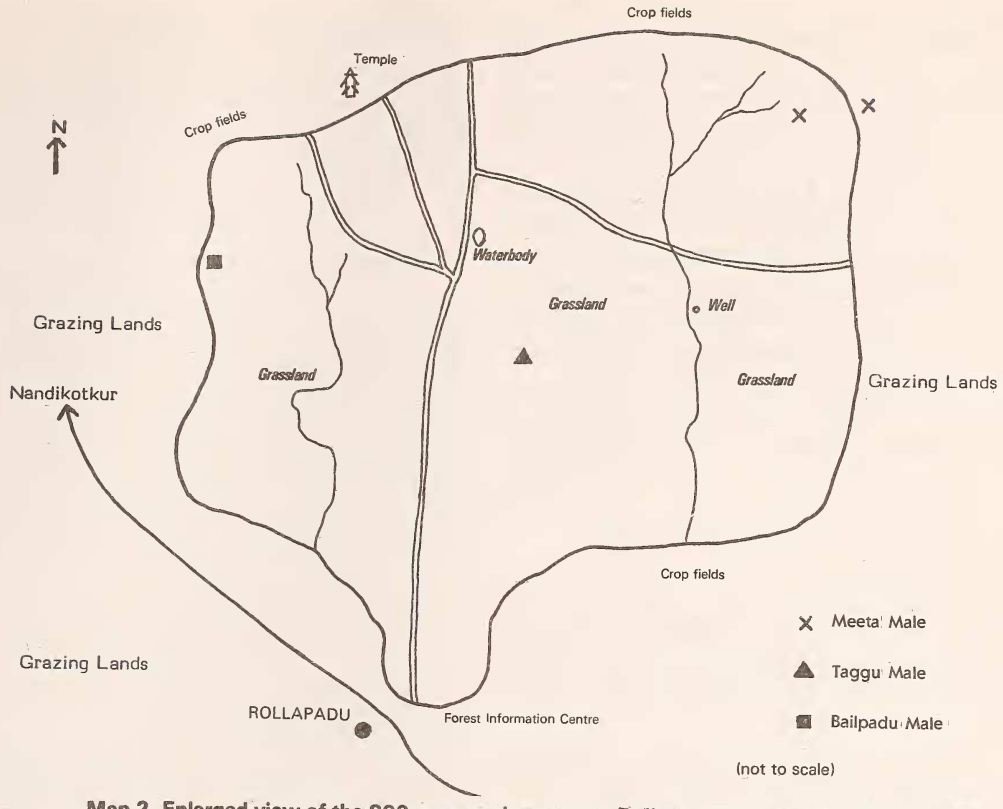
Lesser Florican: *Nela Nemali* (ground peacock) or the lesser florican *Sypheotides indica* is known to *shikaris* in these parts. An old trapper reports that till the severe cyclone that hit the Andhra coast in the summer of 1977–the resultant downpours around Rollapadu were reported to have killed a lot of wildlife–the florican was occasionally seen and one or two displaying cocks were caught every year. Another *shikari* reported seeing a nest once. After that, there were no more further sightings till a few years ago, when a trapper saw a displaying cock in groundnut fields around Nandikotkur.

For the first two years of our study period, we flushed floricans on one or two occasions each year, but did not see any displaying cocks or cocks in breeding plumage, and presumed that the florican did not breed here inspite of the earlier accounts of *shikaris*. The general belief about the florican was that their major breeding grounds are in Gujarat and Madhya Pradesh and the birds 'wintered' in the peninsular inspite of the existence of some breeding records for South India (Jerdon 1864, Ali & Ripley 1969). However, on 10 October 1987, we came across a cock displaying in the enclosure. Display was seen again on 29 October, during which another cock was noted, but further displays stopped abruptly. About the same time, reports of two displaying floricans at about 5 km southeast of Nandikotkur were received and later, on 27 November, a nest was located in a groundnut field. Then, there was a lull in florican activities till 2 January 1988, when a nest was located in the enclosure, and three males started almost daily morning displays till about the end of January. Another nest was also located during this period. Added to these cases, a nest with two chicks was found 23 km west of Rollapadu and then came reports of two nests at Banganapalle. And finally, a month old chick was picked up by a villager a kilometre south of Rollapadu on 27 February 1988.

What caused the sudden spate of florican breeding activity at Rollapadu and the other areas in 1987? Perhaps it was the failure of rains in their main strongholds in Gujarat and Madhya Pradesh (where breeding was not reported that year) which causes the birds to migrate here to breed. However, for birds whose breeding cycle is so intrinsically tied to the monsoon rains, the possibility of a population breeding during the NE monsoon in South India cannot be discounted. As suggested for the bustard, more studies on a long term basis with banded birds will answer these questions.

Demoiselle Crane: Flocks of up to a thousand Demoiselle Cranes *Anthropoides virgo* may be seen in winter. Their arrival reaches a peak in January and February, during which they cause havoc to the sorghum crop. Farmers consider them a pest and there are frequent complaints to the Forest Department regarding crop losses and requests for compensation.

In the winter of 1987/88, there was an unusually large influx of cranes, probably due to the



Map 2. Enlarged view of the 800-acre enclosure near Rollapadu showing the display spots

drought in Gujarat. *Shikaris*, to whom the crane is a prized bird since each can fetch 50 rupees, put the numbers arriving each season at less than 5,000 but say it exceeded 10,000 birds for 1987/88. They put the numbers trapped each year at about 150-200 birds.

Barheaded Goose: The Barheaded Goose *Anser indicus* is reported to be a regular winter visitor to these areas. The goose is also a much sought after species by *shikaris*. In the winter of 1985/86, we saw flocks of about 200-300 geese and up to 500 in 1986/87, but in 1987/88 there was a drastic decline with not more than 32 being seen at a time.

White Stork: The White Stork *Ciconia ciconia* is reported to be a regular winter visitor. *Shikaris* mention that flocks of 50-100 are not uncommon. The largest flock size we saw, was 26 birds in January 1988. In the winter of 1985-86, we saw only two birds.

Black Stork: The southernmost record for the Black Stork *Ciconia nigra* in India was Solapur district (*c.* 18°N) in the state of Maharashtra (Ali & Ripley 1969). However, we saw this stork during every winter at Rollapadu (c. 15°N). The maximum flock size seen was 6 birds in 1985, the other sightings consisted of one, two or three individuals at a time. The storks were mainly seen around November-December (Manakadan 1987).

Harriers: Rollapadu harbours the largest reported wintering population of harriers in India (Rahmani & Manakadan 1986b). Most common is the Montagu's Harrier *Circus pygargus*, followed by the Pale Harrier *Circus macrourus*. The Pied Harrier *Circus melanoleucos* has been recorded on three occasions. The harriers number about a thousand during the peak period.

Blackbuck: On arrival in September 1985, we estimated the blackbuck *Antilope cervicapra* population at about 17 individuals: 3 adult males, 2 subadult males and 12 females. By the end of our studies in May 1988, their population had risen to 35-40.

It will be interesting to note their population in another 5 or 10 years and see whether the blackbuck will pose problems as it does in the Karera Bustard Sanctuary. In Karera, the blackbuck population of about 50-60 animals in 1982 has increased to more than 600 (in 1988) and is a nuisance to farmers due to their crop damage. Villagers say that there used to be more blackbuck at Rollapadu earlier and hunters would come from nearby villages and towns to hunt them. Now, with total protection, the situation will probably end up as in the Karera Bustard Sanctuary.

Wolf: Sightings of the wolf *Canis lupus* are not uncommon at Rollapadu. The largest pack size recorded was 3, but usually only a pair was seen. Breeding was recorded in the enclosure in January/February of 1985, 1986, 1987 but not in 1988.

We have no idea of the population of the wolf in the Sanctuary. As stated earlier, usually a pair was seen and breeding was recorded almost every year. What happens to the young ones reared each year (since we continued to see only a pair)? The presence of wolves is known to all the villagers in these parts. Does it indicate a good population or is it due to movement by a few individuals, and hence sightings of same individuals in different places? The pair at Rollapadu may be seen daily for a few days/ weeks in the enclosure and at other times be missing for long periods. Only radio-collaring a few wolves and studying their movement for a few years will tell us the true status of wolves around Rollapadu.

Fox: Not more than a pair of fox *Vulpes bengalensis* was seen in the enclosure. This species appears to be uncommon in the Rollapadu grasslands.

Jungle Cat: We had no actual sightings of any felines but the presence of *Jungan Billi* is known to the locals. A few have been reported killed while raiding chicken coops. Two species of cats are said to be present. One is grey with a short tail, which tallies to the description of jungle cat *Felis chaus*. The other is said to be bigger than the jungle cat and with a coat similar to that of the leopard cat *Felis bengalensis*. Its identity needs confirmation.

Discussion and Recommendations

The Rollapadu Wildlife Sanctuary with an area of 614 ha. is probably the smallest wildlife sanctuary of our country. Even this expanse of 614 ha. is not in one block, but divided into three portions of varying sizes separated by crop fields and grazing lands. The bustards are not confined to only these 614 ha. but move around in a large area, and as we have described earlier, the bustards come to the grasslands of Rollapadu mainly for breeding. Except during the three or four months of the monsoon, a greater population of the bustards at any given time is present outside the Rollapadu area and therefore, protection of the surrounding areas is important. Unfortunately, we do not have data on colour-marked or radio-collared birds, so we do not know how far the birds move. Due to this lacunae in our knowledge about the bustard, it becomes more important to protect as large a buffer zone as possible.

At present, the areas surrounding the Rollapadu grasslands are still suitable for bustards being marginally cultivated and/or used for livestock grazing. However, the situation in 3 or 4 decades may not remain the same. With the growing human population and the resultant hunger for land, disturbances due to increase in agriculture, livestock population and other human and human-related factors are bound to multiply. A large sanctuary could lessen the shocks of disturbances at its borders, but can a 614 ha. sanctuary withstand this?

It is necessary to include the surrounding bustard frequented areas as a buffer zone. The buffer zone should officially be included into the sanctuary plans so that the Forest Department can have some control in the land use pattern and any major development detrimental to the bustard could be avoided. Elsewhere, we have described

the importance of a large buffer zone in a bustard sanctuary (see Rahmani & Manakadan 1988). Some states like Madhya Pradesh, Rajasthan and Maharashtra have set up bustard sanctuaries with large buffer zones of a few hundred square kilometres and core areas of 100-200 ha. Traditional agriculture and livestock grazing is allowed in the buffer zones, while the core areas are protected from all interferences during the breeding season.

We suggest that the Andhra Pradesh Forest Department demarcate at least 200 sq. km around Rollapadu grasslands as the buffer zone and strict monitoring of the changes in the traditional land use should be coordinated with other government departments. In fact, the original plan of the Forest Department was to have 614 ha. as the core area of the Sanctuary with the surrounding areas as the buffer zone (see Map 1), but unfortunately, the plan was changed. We hope rethinking is done on this issue and more core areas and a buffer zone are added into the Sanctuary.

Lastly, mention must be made about the other bustard areas of Andhra Pradesh. Unfortunately, the protection and conservation measures taken at Rollapadu are not being carried out in the other bustard areas. At Banganapalle, other than the posting of a watchman, no habitat conservation measures have been taken — the bustard lives in crop fields, private lands and overgrazed grasslands. At Hanimireddy-palli in Anantapur district, the plot is overgrazed since the purpose of the plot was afforestation, and not much attention is being paid to the bustard inspite of its endangered status. In all the other areas, i.e. Nellibanda, Peddapadu, Siruvella, Palakurti, Malligeli, Chevalla and Shamshabad where the bustard is known to exist, no protection measures like posting of Forest Department personnel, leave alone habitat conservation, has been undertaken.

We have no idea of the status of the bustard in these areas. No information is available regarding the population of the birds, the trend of the population (whether on the decline or increasing in numbers), breeding records, etc. Their population is probably on the decline with poaching and habitat destruction. The Forest Department should not be content with the success at Rollapadu. The other bustard areas need urgent attention otherwise it will be too late to save them. Posting of watchmen, development of grassland plots, effective protection against poaching and illegal grazing, and generating local support by necessary publicity should be started by in all the important bustard areas.

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REFERENCES

ALI, S. & RIPLEY, S.D. (1969):Handbook of the Birds of India and Pakistan. Volume 2. Oxford University Press, Bombay.

———— & RAHMANI, A.R. (1982-84): Study of Ecology of certain Endangered Species of Wildlife and their Habitat: The Great Indian Bustard. Annual Report 2. pp 100. Bomby Natural History Society, Bombay.

BLANFORD, W.I. (1898): The Fauna of British India including Ceylon and Burma. Birds. Volume 4. Taylor and Francis, London.

BURTON, R.W. (1953): The Great Indian Bustard. *J. Bombay nat, Hist. Soc. 51(2):* 506.

CHAMPION, H.G. & SETH, S.K. (1968):A revised survey of the forest types of India. Govt. of India Press. Nasik.

DABADGHOA, P.M. & SHANKARNARAYAN, K.A. (1973): The Grass Cover of India. ICAR, New Delhi.

ELLIOT, W. (1880): Notes on the Great Indian Bustard with special reference to gular pouch. *Proc. Zool. Soc. London:* 486-489.

HUME, A.O. & MARSHALL, C.H.T. (1879): Game Birds of India, Burma and Ceylon. Vol. I: 1-33. A.C. Hume and C.H.T. Marshall.

JERDON, T.C. (1864): Birds of India Volume III. Published by the author, Calcutta

MANAKADAN, R. (1987): The Black Stork *Ciconia nigra*(Linn.) in Kurnool district, Andhra Pradesh. *J. Bombay nat. Hist. Soc. 84(3)*: 675-76.

———— & RAHMANI, A.R. (1986): Study of Ecology of Certain Endangered Species and their Habitats; the Great Indian Bustard Annual Report 3. pp50. Bombay Natural History Society, Bombay.

PUSHP KUMAR, (1980): Great Indian Bustard in Andhra Pradesh. pp. 164-166. *in* Bustards in Decline. (eds. Paul Goriup & Harsh Vardhan). Tourism & Wildlife Society of India, Jaipur, India.

RAHMANI, A.R. & MANAKADAN, R. (1986A): Movement and Flock Composition of the great Indian bustard at Nanaj, Solapur district, Maharashtra, India. *J. Bombay nat. Hist. Soc. 83:* 17-31.

————- (1986b): A large roost of barriers in Andhra Pradesh, India. ibid. *83* (Supplement): 203-204.

————- ((1988): Bustard Sanctuaries of India. Technical Report 13. pp. 40. *J. Bombay nat. Hist. Soc.*

TOSTEMS, C.A. (1887): A letter. *Stray Feathers 10:* 167-168.